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USNSWC ltr dtd 14 Aug 1975; USNSWC ltr dtd 14 Aug 1975

U. S. NAVAL PROVING GROUND
DAHLGREN, VIRGINIA

REPORT NO 956

WARHEADS FOR AIR TARGET GUIDED MISSILES;
TESTING OF

41st Partial Report

INVESTMENT CAST STEEL TUBE
FOR AIR TARGET GUIDED MISSILES;
FRAGMENTATION TEST OF

FINAL Report

Task Assignment NPG-Re3f-607-1-52

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NPG REPORT NO. 956

U. S. NAVAL PROVING GROUND
DAHLGREN, VIRGINIA

Forty-first Partial Report

on

Warheads for Air Target Guided Missiles; Testing of

Final Report

on

Investment Cast Steel Tube for Air

Target Guided Missiles; Fragmentation Test of

Project No.: NPG-Re3f-607-1-52
Copy No.: 13
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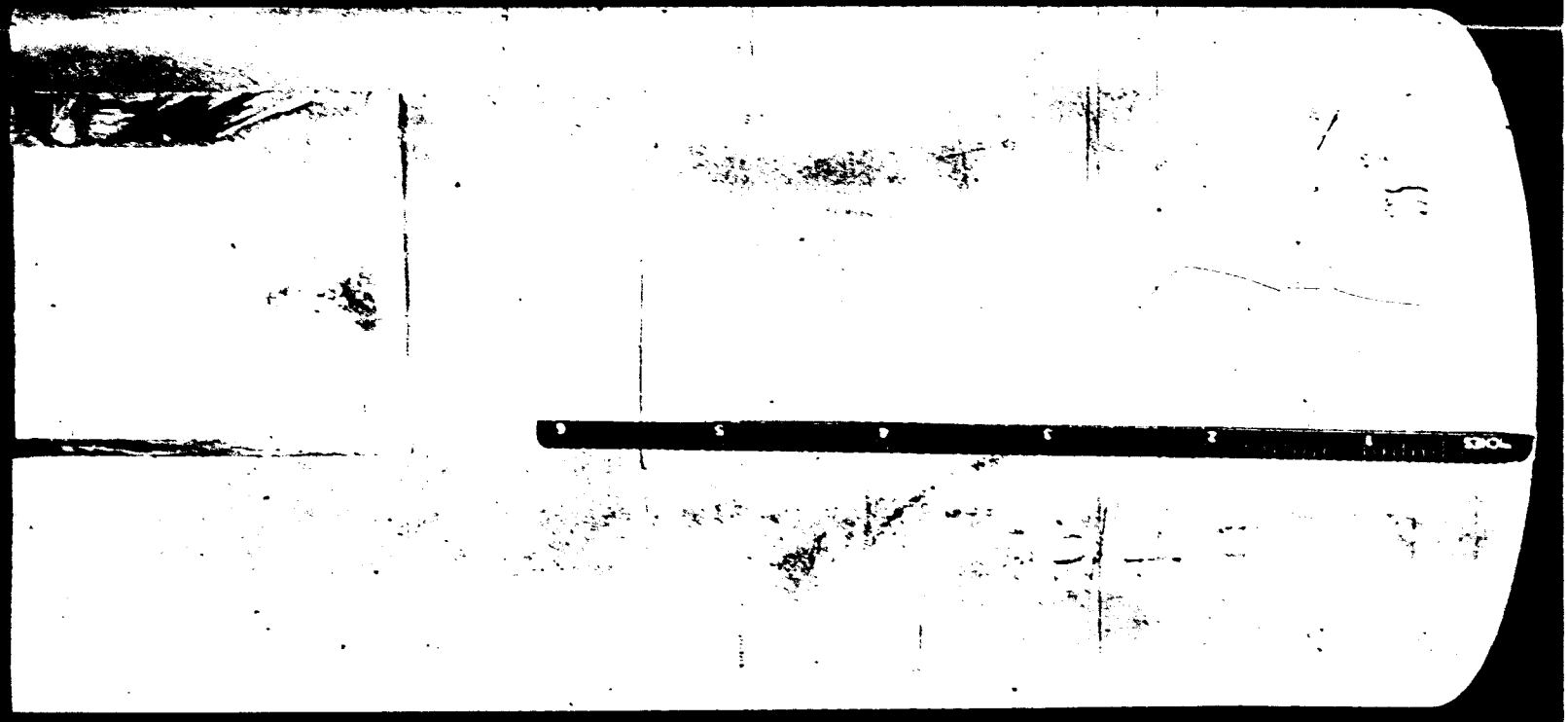
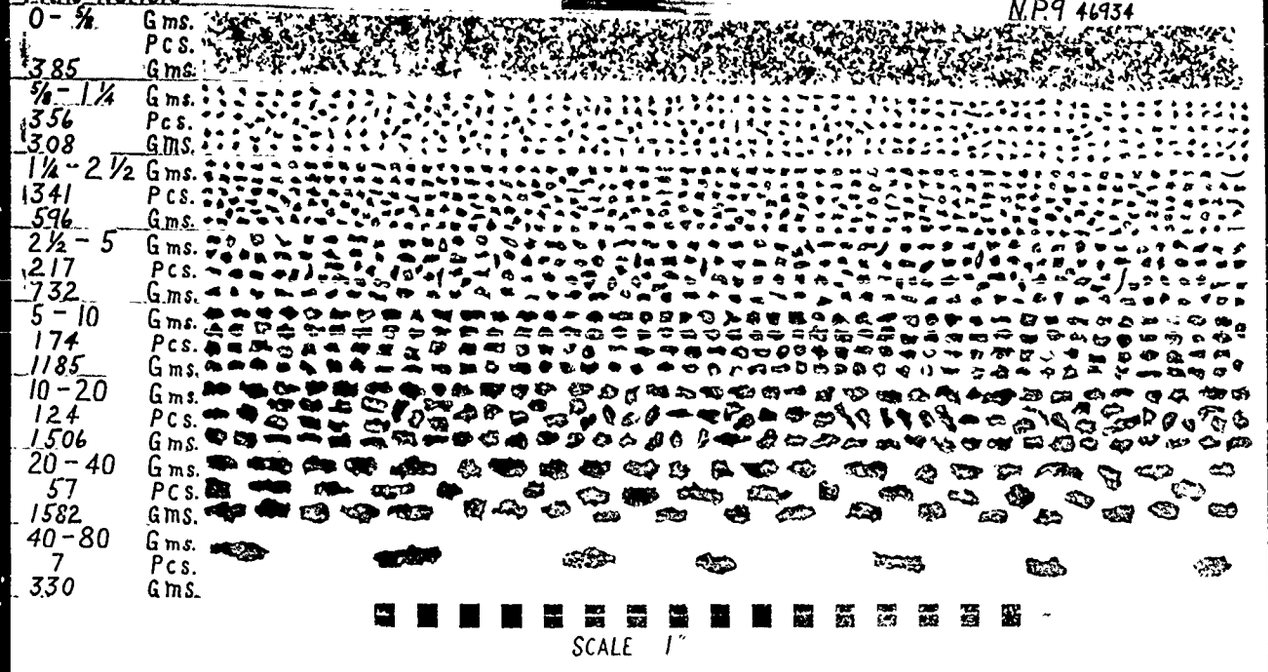
Investment Cast Steel Tube for Air Target Guided Missile, 2 1/2" x 2 1/2" section of tube removed for Tensile Tests.

Figure 1





NP9-46934 4 DECEMBER 1951 CONFIDENTIAL SECURITY INFORMATION

Mass Distribution of 4"6 diameter, 0"45 wall thickness, and 9"25 long, Investment Cast Steel Tube Warhead, Composition C-3 loaded.

Figure 2

Investment Cast Steel Tube for Air
Target Guided Missiles; Fragmentation Test of

TABLE I

MASS DISTRIBUTION DATA

FRAGMENTATION OF INVESTMENT CAST STEEL TUBE WARHEAD: 4".6 O.D.; ".45 WALL, 9".25 LONG, COMP C-3 LOADED
FUZE: SPECIAL ENGINEERS BLASTING CAP AND TETRYL BOOSTER FROM MK 44 AUX. DET.
NUMBER AND WEIGHT OF RECOVERED FRAGMENTS

Rd. No.	Comp. Wt. lb.	Filler Wt. lb.	0-5/8 Grams Wt. Gms.	No.	5/8-1.25 Grams Wt. Gms.	No.	1.25-2.5 Grams Wt. Gms.	No.	2.5-5 Grams Wt. Gms.	No.	5-10 Grams Wt. Gms.	No.	10-20 Grams Wt. Gms.	No.	20-40 Grams Wt. Gms.	No.	40-80 Grams Wt. Gms.	No.	TOTAL Wt. Gms.	No.	Photo No, NP9
1	20.48	5.63	385	---	308	356	596	341	732	217	1185	174	1506	124	1582	57	330	7	6624	1276	46934

Investment Cast Steel Tube for Air
Target Guided Missiles; Fragmentation Test of

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NPG REPORT NO. 956

Investment Cast Steel Tube for Air Target Guided Missiles; Fragmentation Test of

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PART A

SYNOPSIS

1. This test was conducted to determine the fragment mass distribution of a Composition C-3 loaded investment cast steel tube.

2. a. Approximately 70% of the total weight of the warhead fragmented into fragments weighing more than 5 grams each.

b. The fragment mass distribution compared favorably with that obtained from similar steel tubes manufactured by other processes.

Investment Cast Steel Tube for Air
Target Guided Missiles; Fragmentation Test of
[redacted]

TABLE OF CONTENTS

Investment Cast Steel Tube for Air Target Guided Missiles; Fragmentation Test of

PART B

INTRODUCTION

1. AUTHORITY:

This test was authorized by reference (a) and conducted under Task Assignment NPG-Re3f-607-1-52, reference (b).

2. REFERENCES:

a. BUORD Conf ltr NP9 Re3f-EJHL:edb Ser 12896 of 26 Sep 1951
b. BUORD Conf ltr NP9 Re3f-EJHL:edb Ser 25777 of 18 Sep 1951
c. NPG Conf Report No. 705 of 16 Jan 1951
d. NPG Conf Report No. 681 of 15 Nov 1950

3. BACKGROUND:

In the development of warhead cases for air target guided missiles, an investment cast steel tube was manufactured. The casting of steel tubes is a simple and expeditious method of manufacturing warhead cases.

4. OBJECT OF TEST:

This test was conducted to determine the fragment mass distribution of a Composition C-3 loaded investment cast steel tube.

5. PERIOD OF TEST:

a.	Date Project Letter	26 September 1951
b.	Date Necessary Material Received	24 September 1951
c.	Date Commenced Test	4 December 1951
d.	Test Completed	4 December 1951

Investment Cast Steel Tube for Air Target Guided Missiles; Fragmentation Test of

PART C

DETAILS OF TEST

6. DESCRIPTION OF ITEM UNDER TEST:

From an investment cast steel tube, cylindrical, 4".6 outside diameter, ".45 wall thickness, 9".25 long, manufactured by S. D. Hicks and Son Co., a 2 1/2" x 2 1/2" section from one end was removed for physical tests. The physical properties and chemical analysis of this tube were as follows:

Physical Properties: (Tests conducted at NPG)

Test No.	Yield Strength at 0.2% offset (psi)	Tensile Strength (psi)	Elongation (% in 4d)	Reduction of Area (%)
1	28,000	35,800	2.7	5.4
2	24,000	33,100	2.7	6.5
3	22,500	32,400	4.0	10.4
Average	24,800	33,800	3.1	7.4

Chemical Properties: (reported in reference (a))

C	Si	Mn
.10	.39	.69

The warhead was loaded with Composition C-3, and the weights were as follows:

Empty	Comp. C-3	Total
14.85 lbs.	5.63 lbs.	20.48 lbs.

7. PROCEDURE:

The warhead was initiated by a MK 44 auxiliary detonating fuze tetryl pellet and a special engineers blasting cap in a sawdust-filled chamber. After the detonation, the sawdust was sifted and the fragments recovered by the use of sieves and a magnetic separator.

8. RESULTS AND DISCUSSION:

The detailed mass distribution data are listed in Table I and the fragments are shown in Figure 2. The number of fragments in the various weight groups are summarized as follows:

Wt. Group (grams)	No. Fragments	Wt. of Fragments (gm.)	% of Total Weight
40-80	7	330	5
20-40	57	1582	24
10-20	124	1506	23
5-10	174	1185	18
2 1/2 - 5	217	732	11
1 1/4 - 2 1/2	341	596	9
5/8 - 1 1/4	356	308	4
0 - 5/8	---	385	6

Approximately 70% of the total warhead weight fragmented into fragments which were greater than 5 grams in weight. Comparing the fragment sizes with those recovered from similar size warheads manufactured by processes other than casting, references (c) and (d), indicate that the casting of cases may be a satisfactory method for producing warheads. It should be noted, however, that the results reported in references (c) and (d) are for warheads with substantially thinner walls, so that no exact comparison can be made.

Investment Cast Steel Tube for Air
Target Guided Missiles; Fragmentation Test of

PART D

CONCLUSIONS

9. a. Approximately 70% of the total weight of the warhead fragmented into fragments weighing more than 5 grams each.

b. The fragment mass distribution compared favorably with that obtained from similar steel tubes manufactured by other processes.

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Investment Cast Steel Tube for Air Target Guided Missiles; Fragmentation Test of

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